



Terrestrial Planet Finder Mission

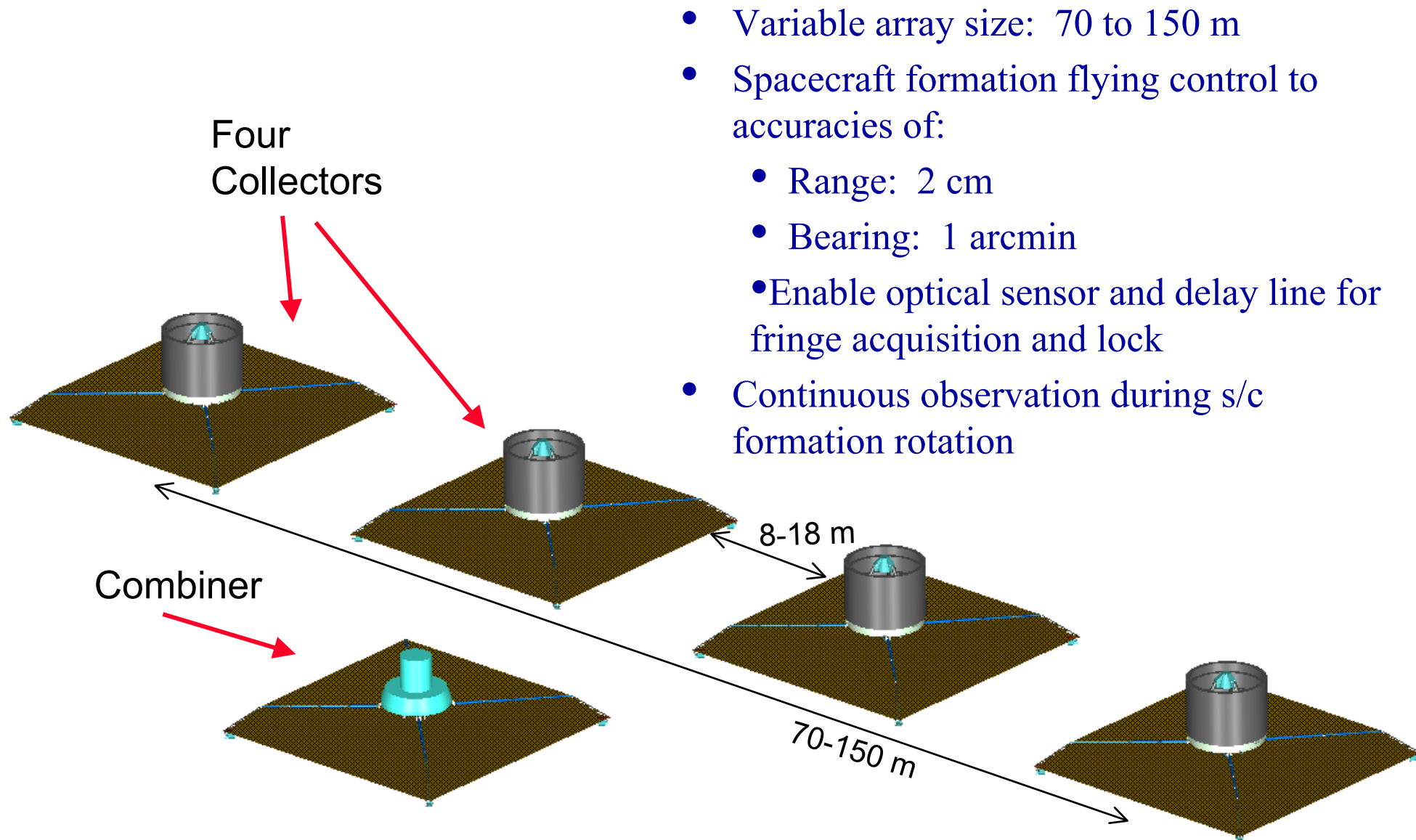
TPF

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Mission

# TPF Formation Flying Technology Overview

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TPF Expo  
10/16/03



# TPF Formation Flying



## Key FF Issues

- Lost-in-space Formation Acquisition
- Collision Avoidance
- Precision Formation Control
- Observation-on-the-fly
- Integrated End-to-end System



## Enabling FF Technologies

- Formation Acquisition Sensor
- On-board Autonomous Guidance & Control
- Control Architecture & Algorithms
- Precision Formation Sensor
- End-to-end System Testbeds

## Infra-structure Technologies

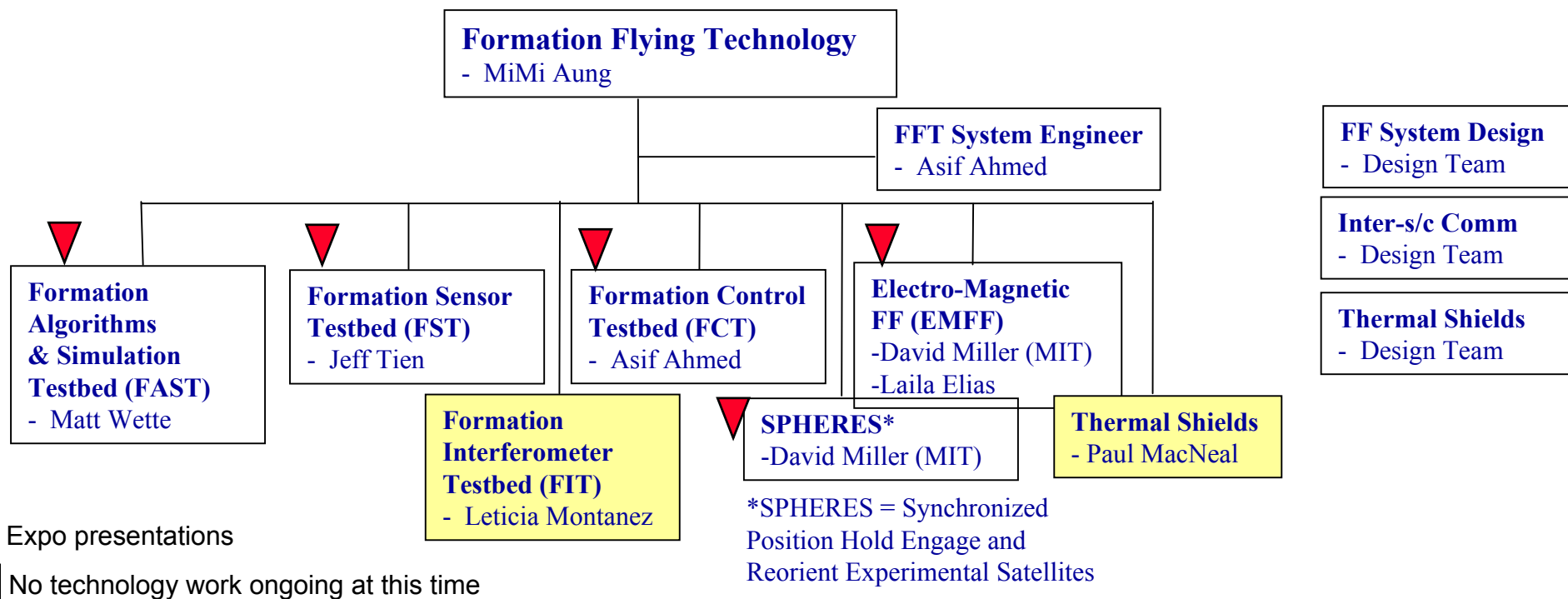
- Inter-spacecraft communications
- Actuation
- Thermal shields



# TPF Formation Flying Technology Activities



- Address key technology issues to establish feasibility of precision formation flying for a FF interferometer mission.
  - Multiple testbeds
  - Interaction with the Design Team FF system design





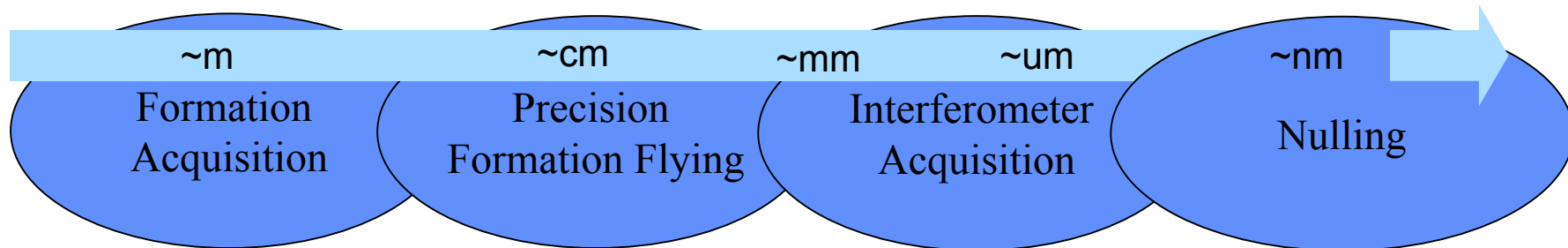
# Integrated FF Technology Development Approach



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## Formation Sensor Testbed (FST)

Formation acquisition sensor hardware & algorithms – scalable to  $4\pi$  steradian coverage.  
Demonstrate & validate the functionality and performance in a hardware testbed

## FAST

Formation control architecture & algorithms in an end-of-end high-fidelity  
formation flying simulations in a distribute real-time environment

## FCT

Validate FAST algorithms in an end-to-end hardware testbed with multiple robots

## MIT SPHERES

Lessons learned from TPF-representative  
formation maneuvers.

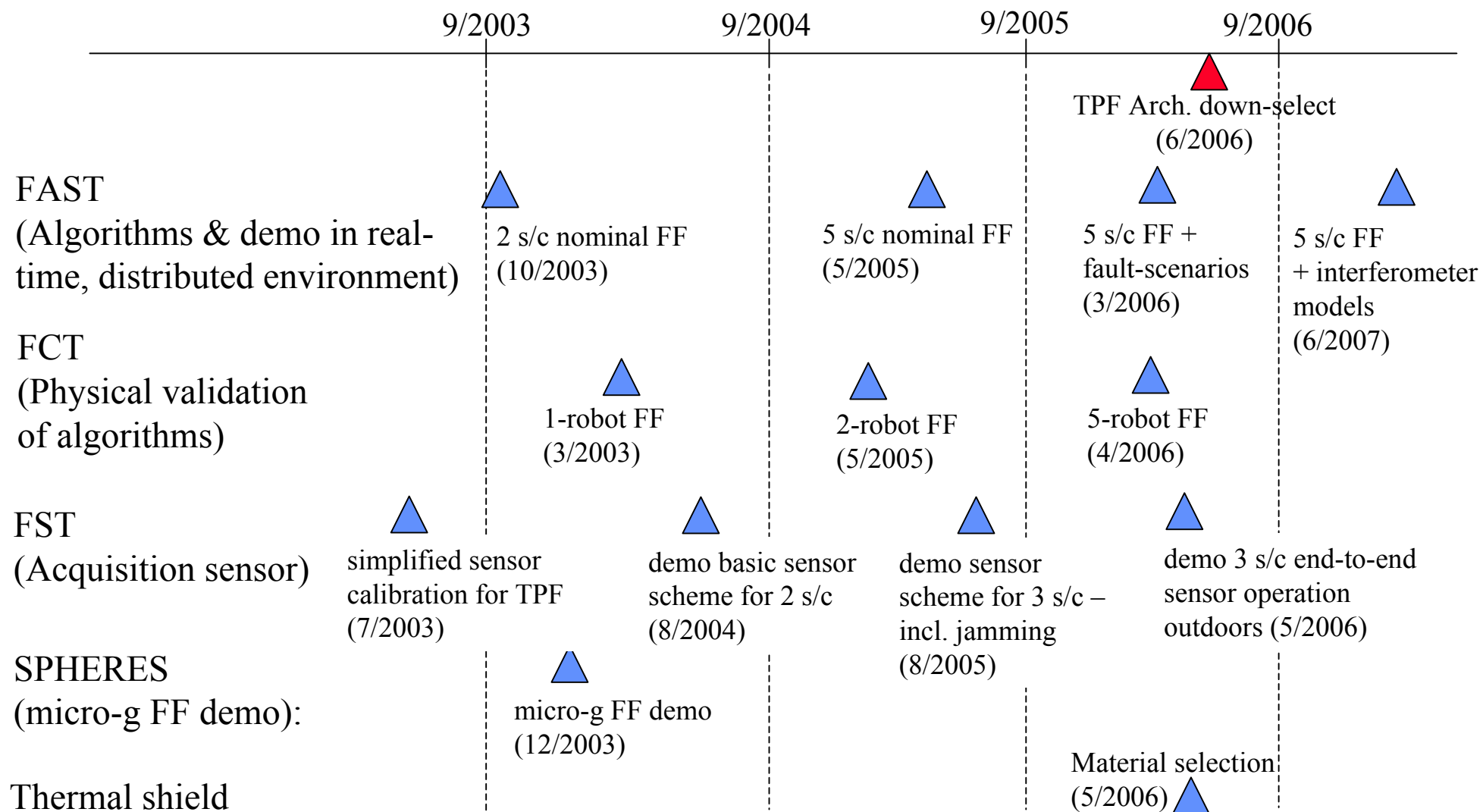
## FIT

Interferometric fringe acquisition and tracking  
across relatively moving platforms

**Infrastructure:** Inter-s/c communications, actuation, thermal shields



# TPF FF Technology Plan



Technology developed consistently with the FF system design in the Design Team



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Back-up

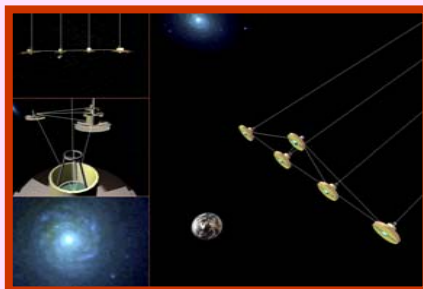
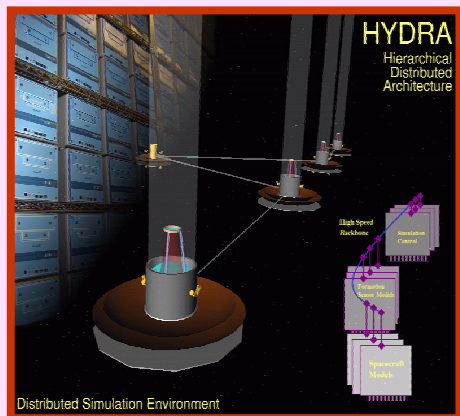




# TPF Formation Flying Technology Testbeds



## Formation Algorithms & Simulation Testbed (FAST)

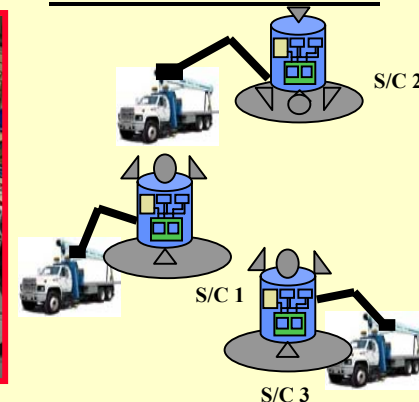


## Formation Sensor Testbed (FST)

### Hardware-in-the-loop testbed

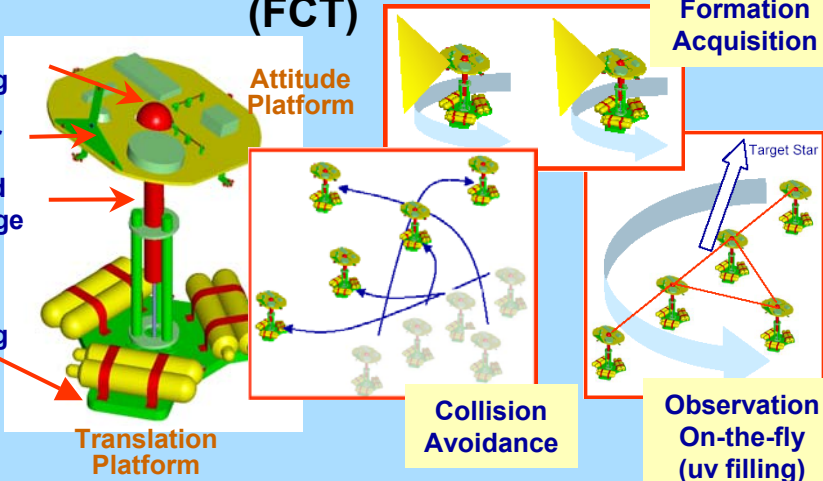


### $4\pi$ -steradian articulated testbed

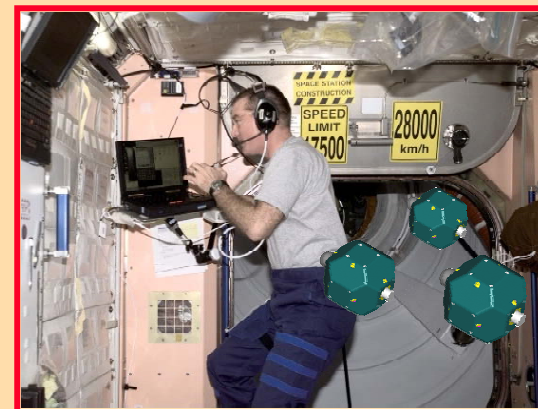


## Formation Control Testbed (FCT)

Spherical Air Bearing  
FF Sensor  
Articulated Vertical Stage  
Linear Air Bearing  
Translation Platform



## MIT SPHERES



Inside International Space Station (ISS)





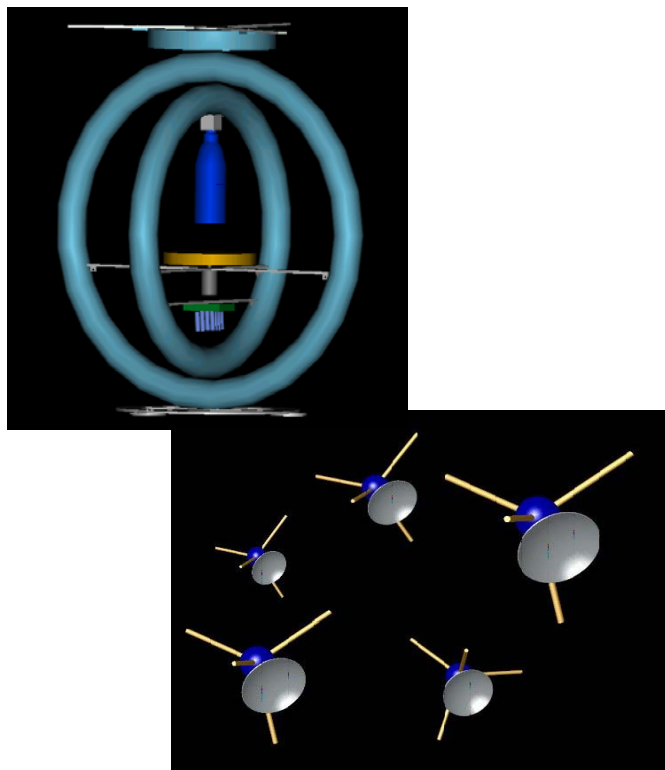
# TPF Formation Flying Technology Testbeds **JPL**

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## Electromagnetic Formation Flying (EMFF)



## Formation Interferometry Testbed (FIT)

